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(54) A face milling cutter

(57) A face milling cutter (1) has interchangeable cutting elements (3), for example reversible carbide tips, located on a backing material (2). Fine adjustment of the cutting elements (3) in the axial and radial directions is achieved by wedge adjusters (8 or 9) for each cutting tip holder (5), which is axially and radially adjustable in grooves (4) of the backing material (2) and to each of which holders a cutting tip (3) is attached.

The wedge adjuster (8) for the radial fine adjustment of the cutting tip holder (5) consists of a plain wedge which is supported with a wedge face (15) on an axially inclined bottom (16) of the groove (4) for guiding the cutting tip holders (5) and which combines with an axially parallel face (17) to form a support for the cutting tip holder (5), and an adjusting screw (19) is provided for the axial movement between the plain wedge (18) and the backing material (2).

The wedge adjuster (9) for the axial fine adjustment of the cutting tip holder (5) consists of a gib or strip (22) which engages in a groove (21) of the cutting tip holder (5), the longitudinal axis (23) of the gib being approximately axially parallel, and which is located on a guide (25) which can be adjusted radially by means of a set screw (24) inclined to the axis (23). The gib (22) engages in a groove (21) of the cutting tip holder (5) and consequently causes an axial movement to the cutting tip holder (5) as a result of the wedge angle between the longitudinal axis of the gib (22) and the longitudinal axis (26) of the adjusting screw (24).

Fig.1

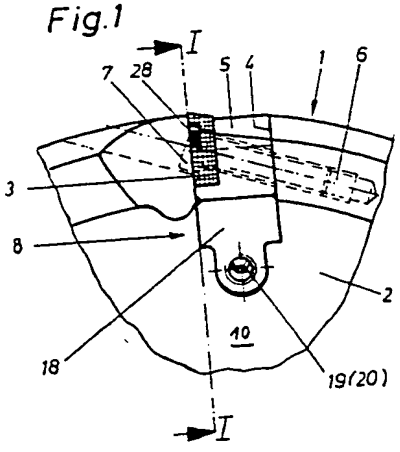
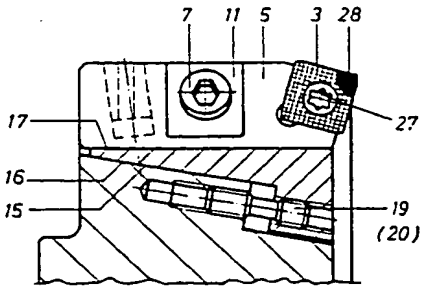


Fig. 2



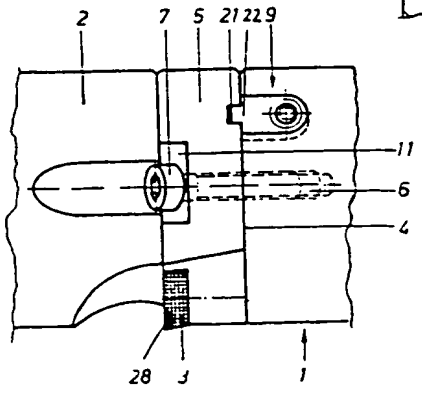


Fig.3

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Fig.1

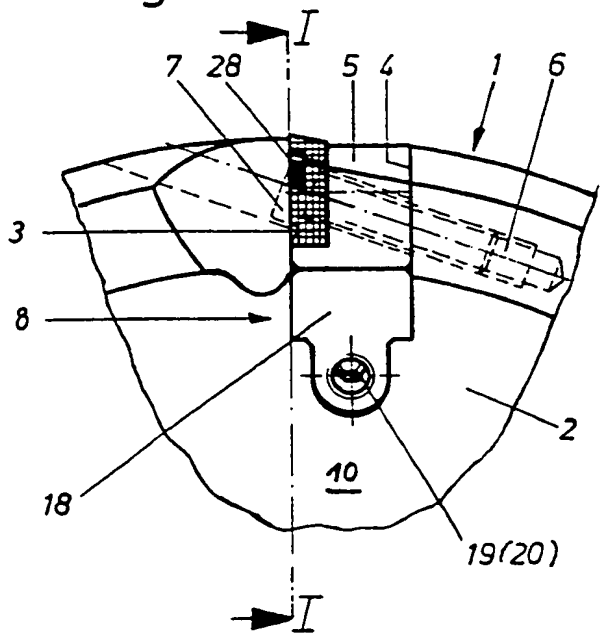
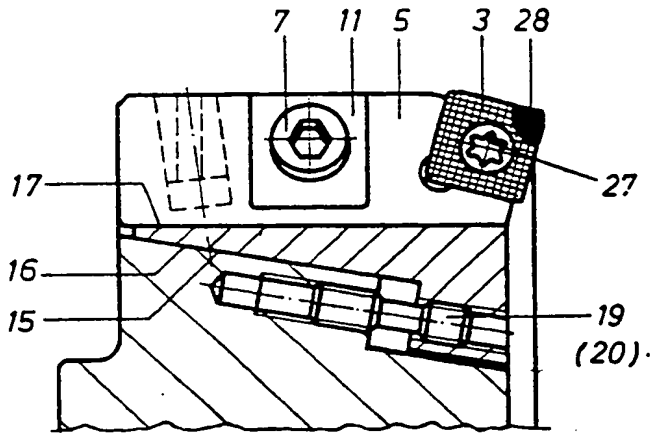


Fig. 2



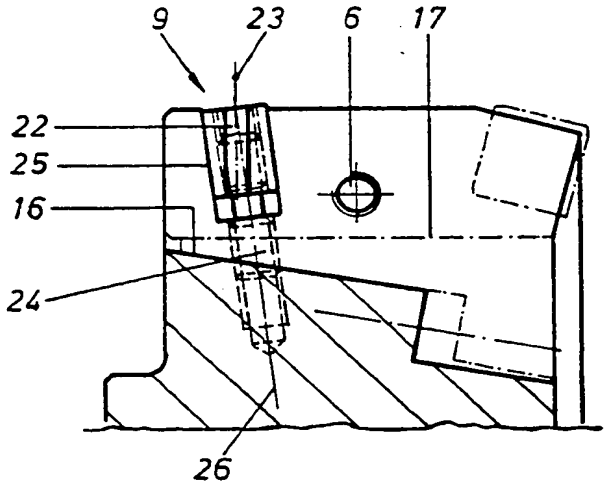


Fig.4

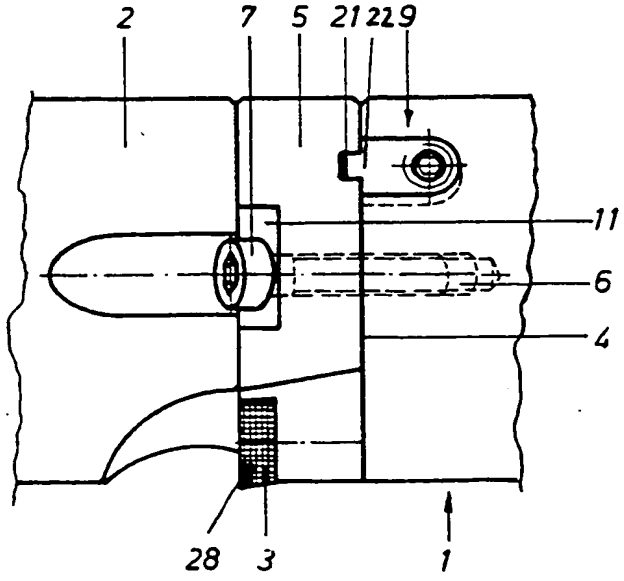


Fig.3

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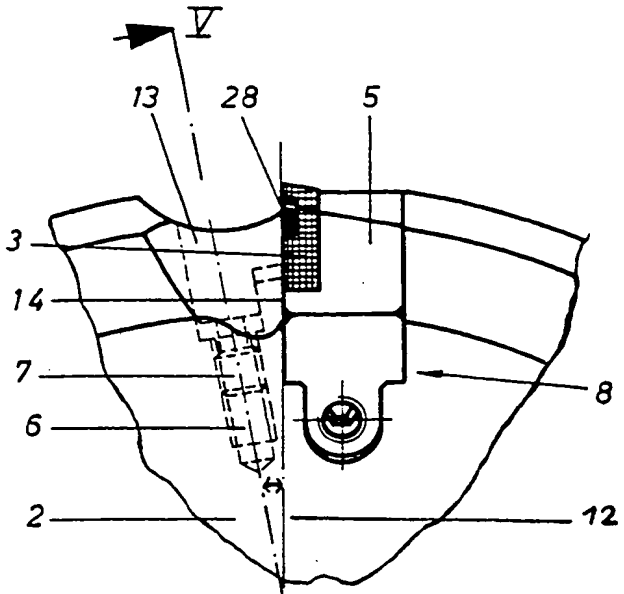

Fig.5

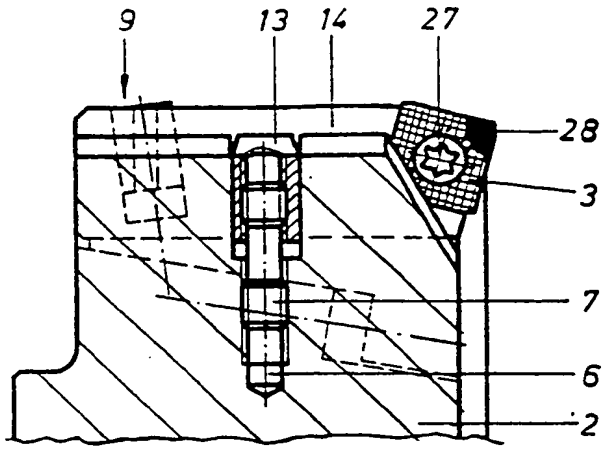

Fig.6

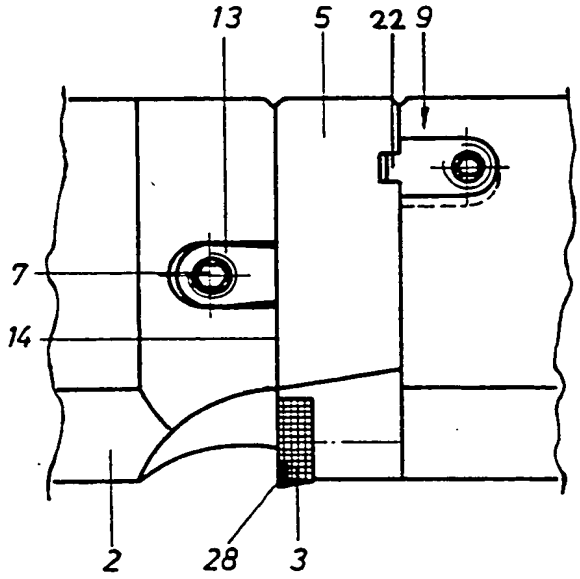

Fig.7

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SPECIFICATION

Face milling cutter, particularly a finishing cutter

This invention relates to a face milling cutter, particularly but not exclusively a finishing cutter, having adjustable cutting elements, for example reversible carbide tips, which are fitted on a base.

With face milling cutters of this type it must be possible for the run-out accuracy, on the one hand, and the true-running accuracy, on the other hand, to be set to the exact μm in the simplest possible manner.

With previously known face milling cutters, this setting is effected by appropriate adjustment of the cutting elements, which are mounted in the base with the aid of wedge elements which bear directly against the cutting elements or bring about an appropriate locking or holding by way of an intermediate piece. The disadvantage with these known face milling cutters is that, in the event of excessive adjustment, immediate reversible adjustment is impossible, and the appropriate locking or clamping elements must be released, and moved back, and the adjustment must begin anew.

In contrast, the present invention seeks to provide a face milling cutter having adjustable cutting elements in such a manner that the fine adjustment of each respective dimension (radial or axial) of the cutting elements in both directions of adjustment can be easily effected and, after a fine adjustment is achieved, secure fastening of the cutting elements is made possible.

According to the present invention there is provided a face milling cutter having adjustable cutting tip elements mounted on a backing material by means of axially and radially adjustable cutting tip holders guided in grooves in the backing material, to each of which cutting tip holders a cutting tip element is attached and which cutting tip holders can be locked by retaining screws engaging in blind holes in the backing material, and wherein a wedge adjuster is provided for the radial fine adjustment of each cutting tip holder and a further wedge adjuster for the axial fine adjustment of each cutting tip holder.

The arrangement of the cutting tips on a cutting tip holder makes it possible for the fine adjustment (true-running accuracy and run-out accuracy) to be effected by adjusting the cutting tip holder, whilst the cutting tip elements themselves can be connected rigidly to the cutting tip holder. The wedge adjusters, which are provided in accordance with the invention, can be attached to appropriate places on the backing material and act upon the cutting tip holder.

It is particularly useful if the grooves in the backing material are substantially axially parallel.

In production engineering it is advantageous if the grooves in the backing material and the cutting tip holders have a substantially square cross-section and/or a substantially rectangular longitudinal section.

In accordance with a first embodiment of the invention the blind holes in the retaining screws are approximately parallel to the surface plane of the backing material and the retaining screws pass through the cutting tip holders and bear against a locating or contact face of the cutting tip holders.

In accordance with a second embodiment of the invention the blind holdes in the retaining screws from an acute angle with a radial plane passing through the cutting elements and the retaining screws engage on a locking wedge which bears against a lateral face of the cutting tip holders. Thus, in this embodiment, the retaining screws are guided only through the backing material and do not pass through the cutting tip holder.

In accordance with a preferred form of the invention, the wedge adjuster for the radial fine adjustment of the cutting tip holders consists of a wedge, which is supported with a wedge face on an axially inclined bottom of the groove for guiding the cutting tip holders and which combines with an axially parallel face to form a support for the cutting tip holder, and an adjusting screw is provided for the relative axial movement between the wedge and the backing material. Operation of the adjusting screw makes it possible for one wedge face to slide along the other and for the flat bottom to move in a radial direction thereby enabling radial fine adjustment. The wedge adjuster is moved in both directions by the differential screw.

The wedge adjuster for the axial fine adjustment of the cutting tip holders preferably consists of a gib or strip which engages in a groove of the cutting tip holders, the longitudinal axis of the gib approximately radial, and which is located on a guide which can be adjusted in the axial direction by means of an axially inclined adjusting screw. This design makes it possible for the gib to be moved axially parallel within the groove for the cutting tip holder when the angularly arranged adjusting screw is operated. This gib engages in a groove of the cutting tip holder and consequently causes an axial movement of the cutting tip holder as a result of the wedge angle between the longitudinal axis of the gib and the longitudinal axis of the adjusting screw. This adjustment can also be effected in both directions.

It is particularly useful if a differential screw having different threads is used as the adjusting screw.

In accordance with a preferred embodiment the longitudinal axis of the gib extends at an angle of between 5 and 10° relative to the longitudinal axis of the differential set screw.

The cutting tips can be attached to the cutting tip holder in a manner known *per se*. A particularly simple fastening is obtained if a locking screw is located in a central hole in the cutting element.

A design which is advantageous for special uses of the face milling cutter according to the invention, for example milling of workpieces made of light metals or alloys thereof, is obtained if cutting elements having polycrystalline cutting

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edges are provided as cutting tips.

Particularly when using cutting elements having polycrystalline cutting edges as cutting tips, it is especially important to enable run-out and true-running accuracy to be set to the exact μm in a simple manner. Such cutting elements with polycrystalline cutting edges are very costly and the regrinding of such polycrystalline cutting edges is a very time-consuming operation. If the polycrystalline inserts are blunted, they are reground, but only as much as is absolutely necessary. Therefore, it is necessary to set run-out and true-running accuracy to the exact μm.

The invention will now be described by way of example with reference to the drawings which show sections of two embodiments. In the drawing:

Figure 1 shows a first embodiment of a face milling cutter in front view.

Figure 2 shows a sectional view along the line I—I in Figure 1,

Figure 3 shows a side view,

Figure 4 shows a partial section through a groove for guiding a cutting tip holder,

Figure 5 shows a second embodiment in front view,

Figure 6 shows a section along the line V—V in Figure 5, and

Figure 7 shows a side view of the embodiment according to Figures 5 and 6.

Figures 1 and 4 show various sections and partial views of a first embodiment of a face milling cutter 1. In a face milling cutter 1 a groove 4, in which a cutting tip holder 5 carrying a cutting element 3 is slidably mounted, is provided in a backing material 2 as shown in Figure 1. In the exemplary embodiment according to Figure 1 the cutting tip holder 5 is, as can be seen particularly from Figure 3, clamped or locked in the groove 4 with the aid of a retaining screw 7 engaging in a blind hole 6. In this case the retaining screw 7 bears against a contact or locating face 11 of the cutting tip holder 5. The blind hole 6 includes an inclined angle with a radial plane passing through the cutting elements 3. The cutting element 3, for example a reversible carbide tip, is attached to one end of the cutting tip holder 5 in a manner known *per se*. A chip space is provided in the backing material 2 in front of the cutting element 3.

A wedge adjuster 8 for the radial fine adjustment or setting of the true-running accuracy is arranged radially below the groove 4. It can be seen from Figure 2 that this wedge adjuster 8 consists of a wedge 18 which has a wedge face 15 supported on a base area 16 of the groove 4, the said base area being inclined to the axis of the face milling cutter. This wedge 18 is slidable in an axial direction with the aid of an adjusting screw 19, for example a differential screw 20, thereby causing an axially parallel face 17 of the wedge 18 to be moved radially. At the same time the cutting tip holder 5 located in the groove 4 is also adjusted radially.

It can be seen particularly from Figure 2 that the cutting element 3 is secured to the cutting tip holder 5 with the aid of a locking screw 27.

A wedge adjuster 9, which is shown in detail in Figure 4, is used for the axial adjustment of the cutting tip holder 5. The wedge adjuster 9 consists of a gib or beading 22 which extends in an approximately radial direction and is located on a guide 25 movably mounted in the backing material 2 with the aid of a set screw 24. In this case the longitudinal axis 26 of the set screw 24 and guide 25 forms an acute angle, preferably of between 5 and 10°, with the longitudinal axis 23 of the gib 22. This design makes it possible for the gib 22 to be moved in an axial direction when the set screw 24 is screwed in an approximately radial direction, since the gib 22 engages in a groove 21 on the cutting tip holder 5, and operation of the set screw 24 causes the cutting tip holder 5 and consequently also the cutting tip 3 to be moved or fine-adjusted in an axial direction. It can be easily seen that the areas or ranges of adjustment for fine adjustment to the run-out or true-running setting are in each case only very small, for example several tenths of a millimetre, thereby making it possible to adjust to the exact μm.

A further embodiment of the face milling cutter according to the invention is shown in Figures 5 to 7 which show views corresponding to those of Figures 1 to 3 respectively. In this connection Figure 5 shows a front view, Figure 6 a sectional view and Figure 7 a side view of this second embodiment. The method of securing the cutting tip holder 5 in the groove 4 differs from that in the first embodiment. A locking or clamping wedge 13, which can be secured by means of a retaining screw 7 engaging in a blind hole 6 in the backing material 2, serves as the fastening means. This locking wedge 13 bears against a lateral face 14 of the cutting tip holder 5. Since the retaining screw 7 in this embodiment no longer passes through the cutting tip holder 5, the design of the cutting tip holder 5 can be simplified. The screw 7 and its associated blind hole 6 form an acute angle with a radial plane passing through the cutting elements.

In this embodiment the retaining screw 7 can, as is evident from Figure 6, consist of, for example, a differential screw.

The wedge adjuster 8 and the wedge adjuster 9 are the same as those shown in the embodiment according to Figures 1 to 4.

For special applications it is useful if the cutting elements 3 are provided with polycrystalline cutting edges 28 which have a substantially longer cutting or blanking life than standard carbide cutting edges.

CLAIMS

1. A face milling cutter having adjustable cutting tip elements mounted on a backing material by means of axially and radially adjustable cutting tip holders guided in grooves in the backing material, to each of which cutting tip holders a cutting tip element is attached and which cutting tip holders can be locked by retaining screws engaging in blind holdes in the

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backing material and wherein a wedge adjuster is provided for the radial fine adjustment of each cutting tip holder and a further wedge adjuster for the axial fine adjustment of each cutting tip holder.

2. A face milling cutting according to Claim 1, wherein the grooves in the backing material are substantially axially parallel.

3. A face milling cutter according to Claim 1 or 2, wherein the grooves in the backing material and the cutting tip holders have a substantially square cross section and/or a substantially rectangular longitudinal section.

4. A face milling cutter according to Claim 1, 2 or 3 wherein the blind holes of the retaining screws are approximately parallel to the surface plane of the backing material, and the retaining screws pass through the cutting tip holders and bear against a locating or contact face of the cutting tip holders.

5. A face milling cutter according to any one or more of Claims 1 to 3, wherein the blind holes of the retaining screws form an acute angle with a radial plane passing through the cutting elements, and the retaining screws engage on a locking wedge which bears against a lateral face of the cutting tip holders.

6. A face milling cutter according to any one of Claims 1 to 5 wherein the wedge adjuster for the radial fine adjustment of the cutting tip holders consists of a plain wedge which is supported with a wedge face on an axially inclined bottom of the groove for guiding the cutting tip holders and which combined with an axially parallel face to form a support for the cutting tip holder, and an adjustable screw is provided for the relative axial movement between the plain wedge and the backing material.

7. A face milling cutter according to any one of Claims 1 to 6, wherein the wedge adjuster for the axial fine adjustment of the cutting tip holders consists of a gib or strip which engages in a groove of the cutting tip holders, the longitudinal axis of the gib being approximately radial, and which is located on a guide which can be moved in the axial direction by means of an adjusting screw inclined to the axis.

8. A face milling cutter according to Claims 6 or 7, wherein the adjusting screw comprises a differential screw having different thread pitches.

9. A face milling cutter according to Claim 8, wherein the longitudinal axis of the gib extends at an angle of between 5 and 10° relative to the longitudinal axis of the differential set screw.

10. A face milling cutter according to any one of Claims 1 to 9 wherein the cutting tip elements are secured on the cutting tip holder by means of a locking screw.

11. A face milling cutter according to any one of Claims 1 to 10, wherein the cutting tip elements have polycrystalline cutting edges as cutting tips.

12. A face milling cutter according to any one of Claims 1 to 10 wherein the cutting tip elements have reversible carbide tips.

13. A face milling cutter according to any one of Claims 1 to 12 and comprising a finishing cutter.

14. A face milling cutter substantially as described herein with reference to and as illustrated in Figures 1 to 4 or Figures 4 to 7 of the accompanying drawings.

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